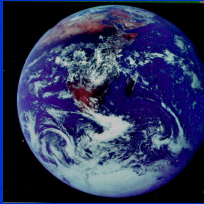


## Ecology of Disease

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Theme: Agriculture  
Lecture: Animal Production



Prof Peter O'Donoghue


1

## Agriculture

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Free-range animals

- domestic ruminants
- herdsmen (pastoralists)




Penned animals

- intensive production
- farmer (husbandry)

Cultivated plants

- cereals, fruit, vegetable
- gardeners (horticulture)



2

## Main domestic animal species

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**Mammals**

- Ruminants (foregut fermenters)
  - cattle *Bos taurus*
  - sheep *Ovis aries*
  - goats *Capra hircus*
- Suidae (monogastrics)
  - pigs *Sus scrofa*

**Birds**

- Galliformes (fowl)
  - chickens *Gallus gallus*


3

## Penned animals

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**Intensive grazing**  
(animals go to food)

- improved pastures (grass types)
- year-round pastures (irrigation)
- high stocking density



**Production units**  
(food brought to animals)

- cattle stalls - dairies, feedlots
- pig stys - intensive piggeries
- chicken runs - battery hens



4

## Problems with intensive systems

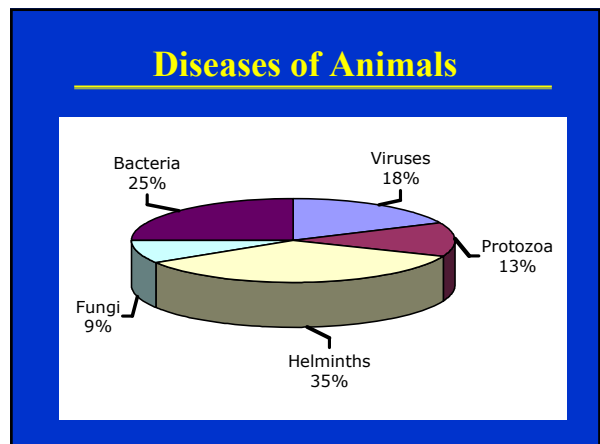
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Marked "crowding" effects

- hosts in close proximity (frequent contact)
- hosts under stress (behavioural/environmental)
- physiological manifestations (hormonal)
- reduced immunity (decreased competence)
- increased susceptibility (ease of infection)
- age-cohorts gathered together (epidemics)
- greater environmental contamination

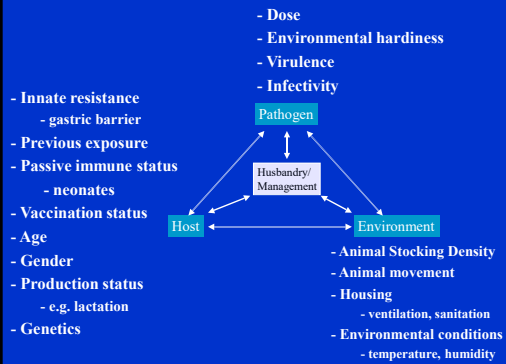
→ all of which facilitates easier transmission

5



6

## The Epidemiological Triad



7

## Exemplars of breakdown of epidemiological triad

### Bovine mastitis

- bacterial infection
- dairy cattle
- significant morbidity

### Marek's disease

- viral infection
- chickens
- significant mortality



8

## Bovine Mastitis

- **Inflammation of mammary gland**
  - swelling
  - pain
  - soreness
- **Commonly associated with infection**
  - bacteria (~ 70%)
  - fungi (~ 2%)
  - unknown (~ 28%)



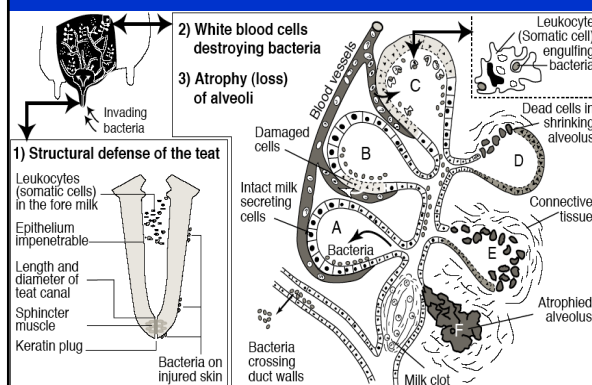
9

## Bovine Mastitis

- bacteria enter gland
- trigger inflammatory response
- vasodilation (increased blood flow)
- increased permeability (fluids)
- swelling of tissues
- increased diapedesis (leucocytes)
- phagocytosis of bacteria
- tissue repair, scarring
- temporary/permanent loss of milk secreting tissue

10

## Bovine Mastitis



11

## Bovine Mastitis

- **Impact (~\$2 billion in US)**
  - mortality, morbidity
- **loss of production**
  - low quality milk (lactose synthesis decreased; casein proteolysis by plasmin (blood) and enzymes (bacteria) leads to poor curdling therefore lower cheese yield); somatic cells/leukocytes increase in number (diagnostic)
  - impaired reproductive performance
- **increased costs**
  - veterinary intervention
- **unacceptable residues**
  - antibiotics in milk

12

## Bovine Mastitis

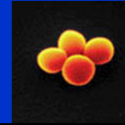
- Clinical (5-10% cases)
  - inflamed udder
  - acute/chronic onset
  - clumps/clots in milk
  - loss of appetite
  - prompt attention needed
- Subclinical (90-95%)
  - udder appears normal
  - milk appears normal
  - lowered milk output (~10%)
  - decreased milk quality
  - persistent



13

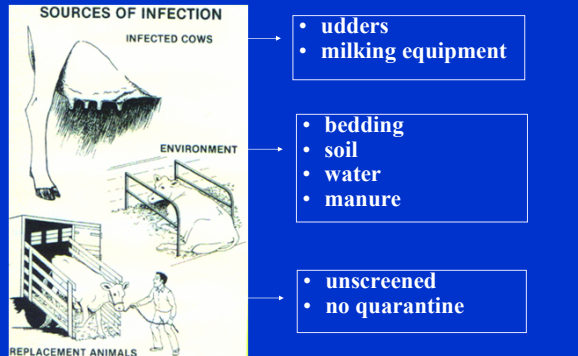
## Bovine Mastitis

- Environmental mastitis
  - environment to cow
  - coliforms (*E. coli*, *Enterobacter aerogenes* etc)
  - environmental streptococci (*S. uberis*, *S. dysgalactiae* etc)
  - primary sources
    - environment
- Contagious Mastitis
  - cow to cow
  - *Streptococcus agalactiae*
  - *Staphylococcus aureus*
  - primary sources
    - udders of infected cows



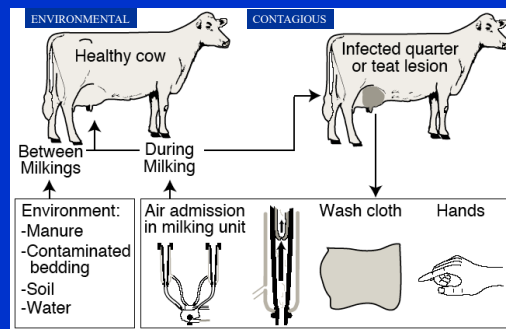
14

## Bovine Mastitis



15

## Bovine Mastitis



16

## Bovine Mastitis

- Eliminate infections
  - treat with antibiotics
  - cull chronically infected cows
- Prevent infections
  - Improved milking procedures
    - Wash, clean and dry teats prior to milking
    - Antibacterial teat dip
    - Maintenance of milking equipment (reduce teat injury)
  - Nutrition
    - Adequate levels of vitamin E and selenium reduce incidence
  - Vaccines
    - *E. coli* vaccine available
  - Reduce contamination
    - keep environment clean and dry; no manure/mud/water
    - keep bedding dry, low temperature, devoid of nutrients

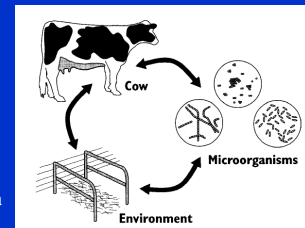
17

## Bovine Mastitis

Results from breakdown of epidemiological triad

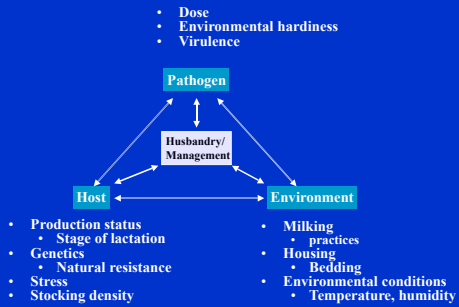
Failure in "status quo" between:

- host resistance,
- mastitis-causing bacteria
- and environment



18

## Bovine Mastitis



19

## Marek's Disease



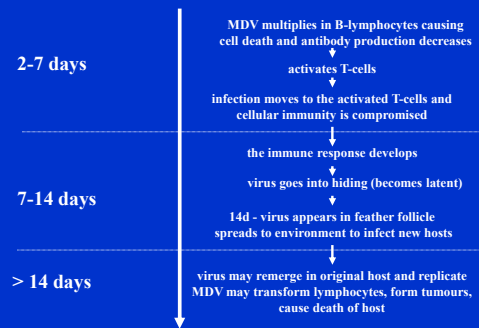
20

## Marek's Disease

- Caused by Marek's Disease Virus (MDV)
  - Member of the herpesviruses
  - Highly transmissible - airborne
  - Survives in environment
  - Transmission - feather follicle skin cells (dander)
  - Yearly economic losses from MD total greater than \$1 billion worldwide.

21

## Marek's Disease



22

## Marek's Disease



Classical symptoms of Marek's disease - tumours in peripheral nerves leading to paralysis

23

## Marek's Disease

- Disease management
  - Disease expression modified by the introduction of
    - vaccination strategies
    - management practices
  - Led to changes in virus (evolution)
  - Led to changes in management strategies

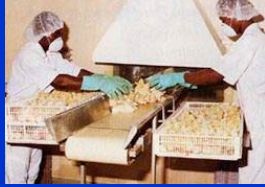


24

## Marek's Disease

### Vaccination

- live vaccine
- infection follows same path as “normal” infection
- but no tumours produced
- must be given prior to “wild” infection
- does not stop “wild” infection
- stops transformation to tumour causing cells



25

## Marek's Disease

- **Vaccination Failure!**
  - First used in Australia in the 1970s
  - “Wild” viruses found that overcame vaccines
    - vvMDV - very virulent MDV (faster multiplication)
  - vvMDV taking hold due to selection pressure:
    - from vaccination practices
    - from management practices

26

## Marek's Disease

- **High density farming**
  - geographical clustering of farms
    - MDV can spread large distances (2-3Km)
  - Mixed farming practices (layers + broilers)
    - More chickens shedding virus
    - More potential hosts (especially young birds)
- **Higher weight (age) of broiler flocks**
  - prior to 1991, broilers grown to ~45 days of age
  - after 1991, broilers grown to ~63 days of age
    - viral shedding at a higher rate
    - greater environmental load
    - higher challenge



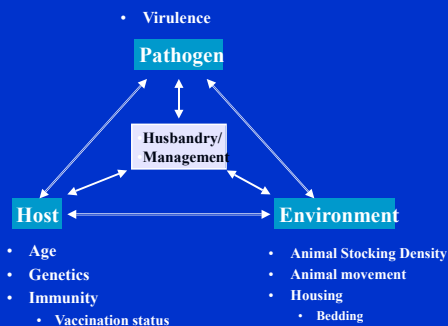
27

## Marek's Disease

- **Introduction of genetic lines**
  - “better birds”
  - higher MDV susceptibility
  - response to vaccination – low
- **Deregulation of the layer industry**
  - economic hardship / profit margins (return to “bad-management” practices)
    - multi-age farms
    - increased movement of birds

28

## Marek's Disease

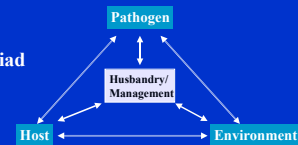


29

## What's examinable?



### Epidemiological triad



- Crowding effects facilitate easier transmission
  - hosts in close proximity (frequent contact)
  - hosts under stress (behavioural/environmental)
  - physiological manifestations (hormonal)
  - reduced immunity (decreased competence)
  - increased susceptibility (ease of infection)
  - age-cohorts gathered together (epidemics)
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30